OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **PROVINCE LAKE,** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- Figure 1: These graphs illustrate concentrations of chlorophyll-a, also a measure of algal abundance, in the water column. Algae are microscopic plants that are a natural part of lake ecosystems. Algae contain chlorophyll-a, a pigment necessary for photosynthesis. A measure of chlorophyll-a can indicate the abundance of algae in a lake. The historical data (the bottom graph) show a *fairly stable* in-lake chlorophyll-a trend. The lake experienced a slight increase in mean chlorophyll concentrations this season as compared to last year. The increase in rain the state experienced this season likely caused an increase in phosphorus input to the lake from watershed runoff. Algal abundance remained well below the NH mean reference line again this season. While algae are present in all lakes, an excess amount of any type is not welcomed. Concentrations can increase when there are external and internal sources of phosphorus, which is the nutrient algae depend upon for growth. It's important to continue the education process and keep residents aware of the sources of phosphorus and how it influences lake quality.

- Figure 2: Water clarity is measured by using a Secchi disk. Clarity, or transparency, can be influenced by such things as algae, sediments from erosion, and natural colors of the water. The graphs on this page show historical and current year data. The lower graph shows a *fairly stable* trend in lake transparency. June transparency was low, and the slightly higher chlorophyll concentrations could have decreased the transparency of the lake. Mid-summer transparencies were higher and correspond to the decrease in chlorophyll concentrations at that time. The 2000 sampling season was considered to be wet and, therefore, average transparency readings are expected to be slightly lower than last year's readings. Higher amounts of rainfall usually cause more eroding of sediments into the lake and streams, thus decreasing clarity.

- Figure 3: These figures show the amounts of phosphorus in the epilimnion (the upper layer in the lake) and the hypolimnion (the lower layer); the inset graphs show current year data. Phosphorus is

the limiting nutrient for plants and algae in New Hampshire waters. Too much phosphorus in a lake can lead to increases in plant growth over time. These graphs show a *fairly stable* trend for in-lake phosphorus levels. Mean phosphorus concentrations were the lowest Province Lake has ever experienced, and fell on the median line for NH lakes for the first time! Concentrations were relatively uniform throughout the season, and we hope to see this trend continue for the lake. One of the most important approaches to reducing phosphorus levels is educating the public. Humans introduce phosphorus to lakes by several means: fertilizing lawns, septic system failures, and detergents containing phosphates are just a few. Keeping the public aware of ways to reduce the input of phosphorus to lakes means less productivity in the lake. Contact the VLAP coordinator for tips on educating your lake residents or for ideas on testing your watershed for phosphorus inputs.

OTHER COMMENTS

- **Please note** in June this summer phosphorus levels were found to be less than 5 µg/L in Campground Inlet. The NHDES Laboratory Services adopted a new limit for reporting total phosphorus this year and the lowest value that can be recorded is 'less than 5 µg/L'. We would like to remind the association that a reading of 5 µg/L is considered low for New Hampshire's waters.

- A hypolimnion (lower water layer) sample was taken in June during the biologist's visit. The sample was very turbid (Table 11) and as a result, the phosphorus concentration was elevated. Bottom sediment, which normally has phosphorus bound to it, can raise phosphorus concentrations and yield inaccurate results. We did not include the phosphorus results of the hypolimnion in the graph (Figure 3) for this reason.

- Dissolved oxygen was back to normal and high at all depths of the lake in June this season (Table 9). As stratified lakes age, oxygen is depleted in the lower layer by the process of decomposition. Last season was the first time oxygen was depleted on the bottom of the lake in August. We are glad to see that oxygen levels were high in June this season, however there could be the possibility that by August oxygen falls to a critical level. We recommend scheduling a lake visit with the biologist in August for the upcoming season so that we can rule out the possibility of this phenomena occurring.

- Phosphorus concentrations in Island Inlet continue to be elevated (Table 8). July and August had the highest results, and the heavy rain experienced prior to testing most likely washed nutrients into the inlet from the surrounding watershed. Fertilizers, detergents, septic system leachate, agricultural runoff, and erosion can all cause an increase in phosphorus concentrations. We recommend more intense

testing of the inlet by adding upstream sites to help identify possible sources of phosphorus to the inlet. If volunteers are interested in adding upstream testing sites, please contact the VLAP Coordinator at 271-2658 to request extra sets of bottles.

- This season, Rt. 153 Inlet experienced the lowest mean phosphorus concentration ever seen for the inlet. Phosphorus concentrations throughout the summer remained low for the inlet. This is a positive sign and we hope to see a trend like this continue for the inlet.

NOTES

- Monitor's Note (7/23/00): Heavy rain on the 18th with hail and lightning.
- Monitor's Note (8/24/00): Heavy rain 8/23 p.m.
- Biologist's Note (8/24/00): Samples not run in 24 hours.

USEFUL RESOURCES

Minimum Shoreland Protection Standards, WD-BB-36, NHDES Fact Sheet. (603) 271-3503 or www.state.nh.us

Proper Lawn Care Can Protect Waters, WD-BB-31, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, WD-BB-9, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Effects of Phosphorus on New Hampshire's Lakes, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

Vegetated Phosphorus Buffer Strips, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

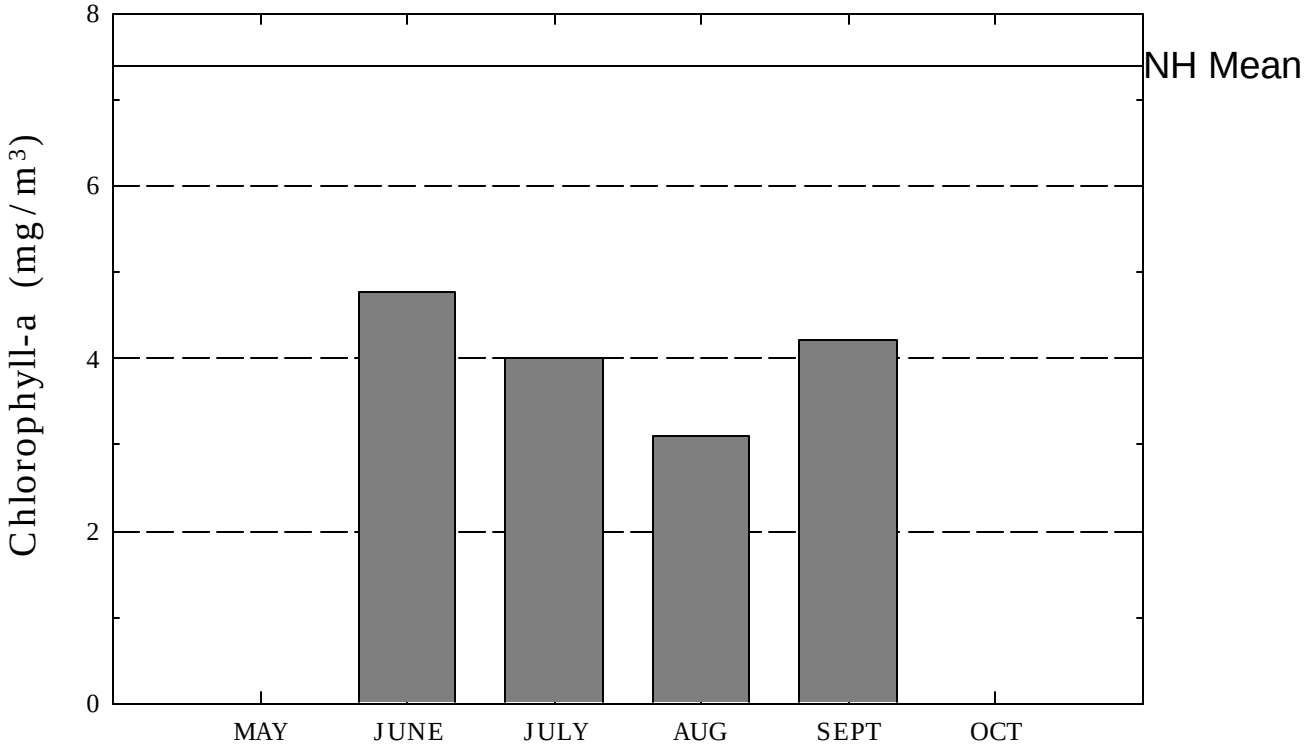
Nonpoint Source Pollution and Stormwater Fact Sheet Package. Terrene Institute. (703) 661-1582.

The Watershed Guide to Cleaner Rivers, Lakes, and Streams, Connecticut River Joint Commissions, 1995. (603) 826-4800

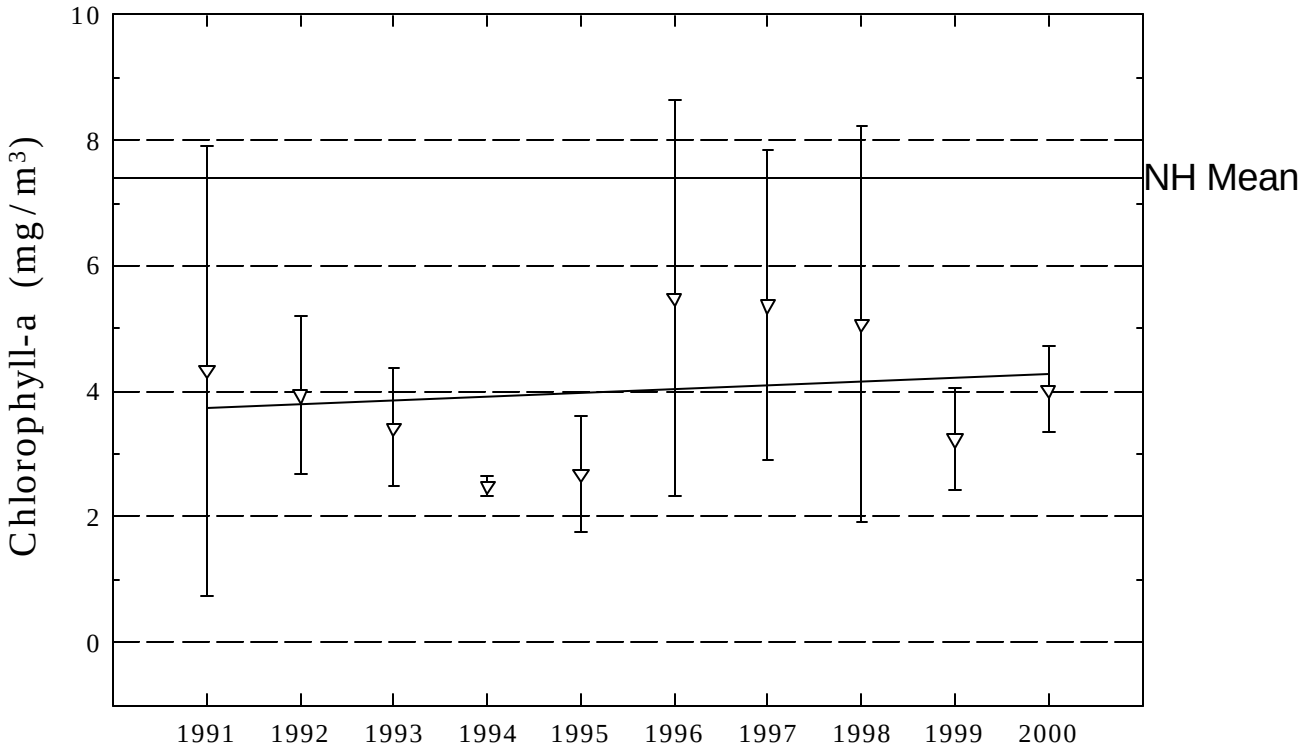
Through the Looking Glass: A Field Guide to Aquatic Plants. North American Lake Management Society, 1988. (608) 233-2836 or www.nalms.org

Province Lake

Figure 1. Monthly and Historical Chlorophyll-a Results



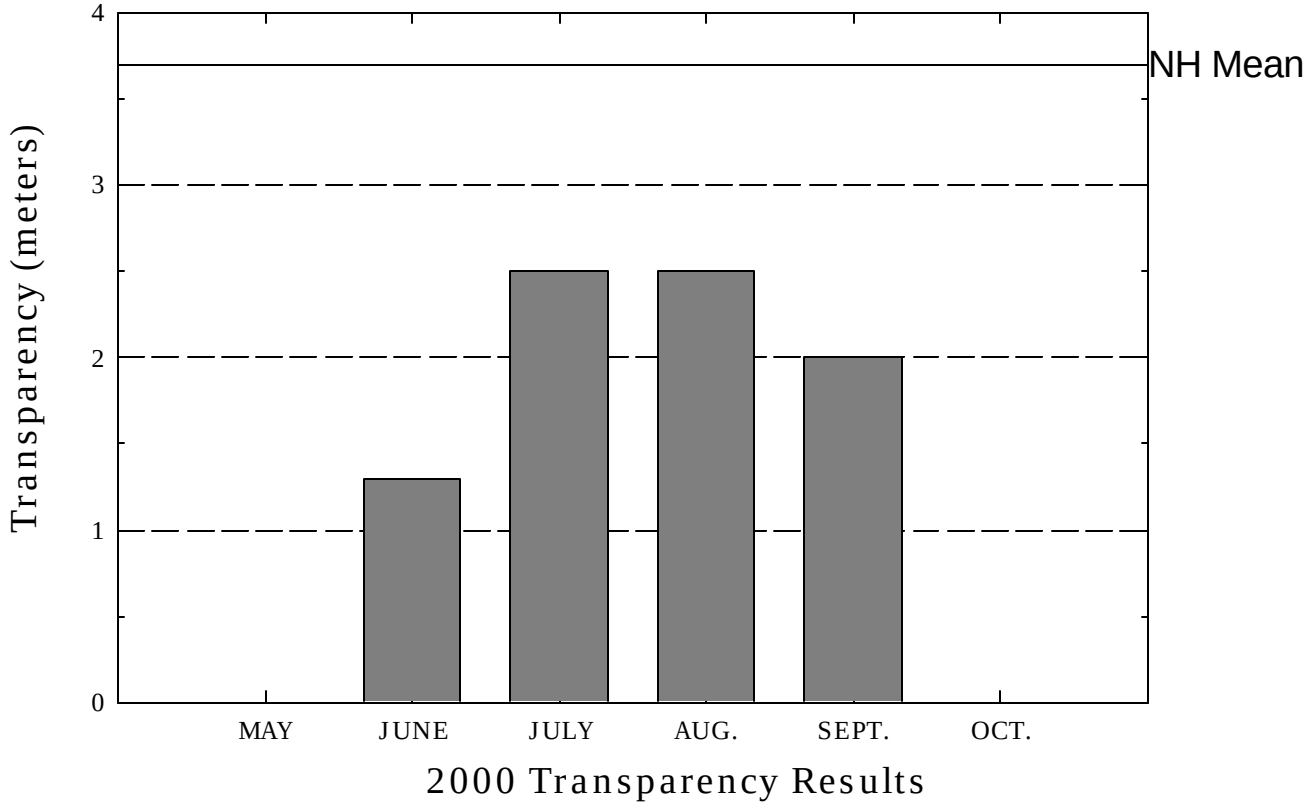
2000 Chlorophyll-a Results

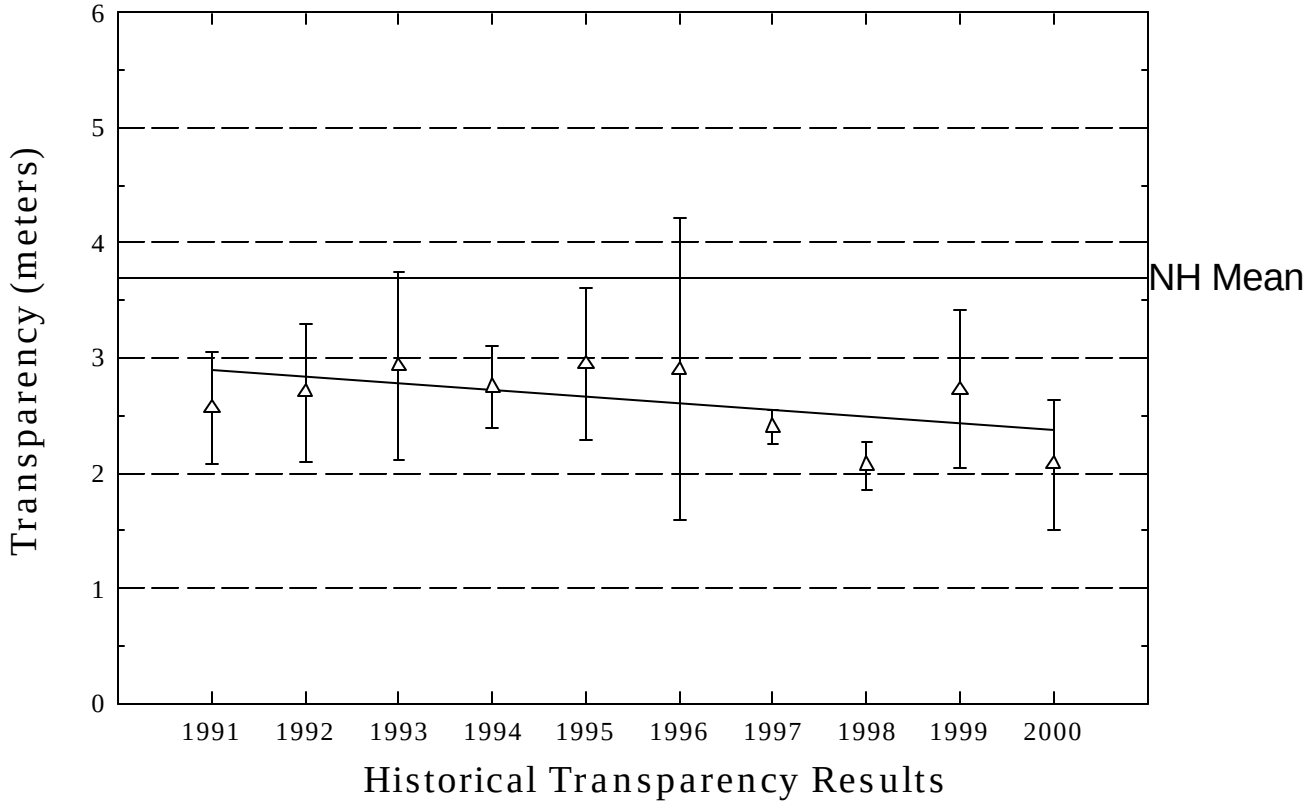


Historical Chlorophyll-a Results

Province Lake

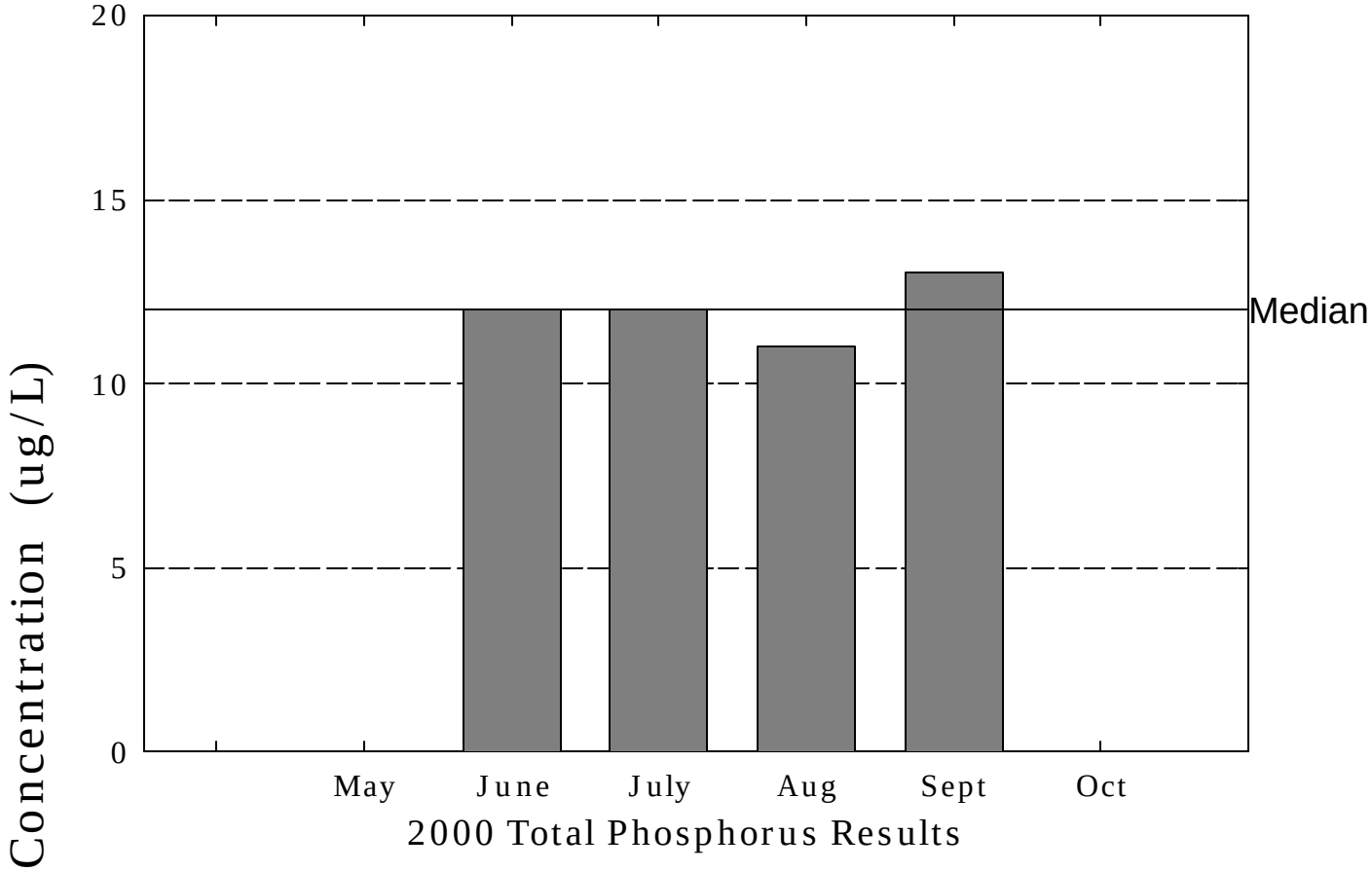
Figure 2. Monthly and Historical Transparency Results





Province Lake

Figure 3. Monthly and Historical Total Phosphorus Data.



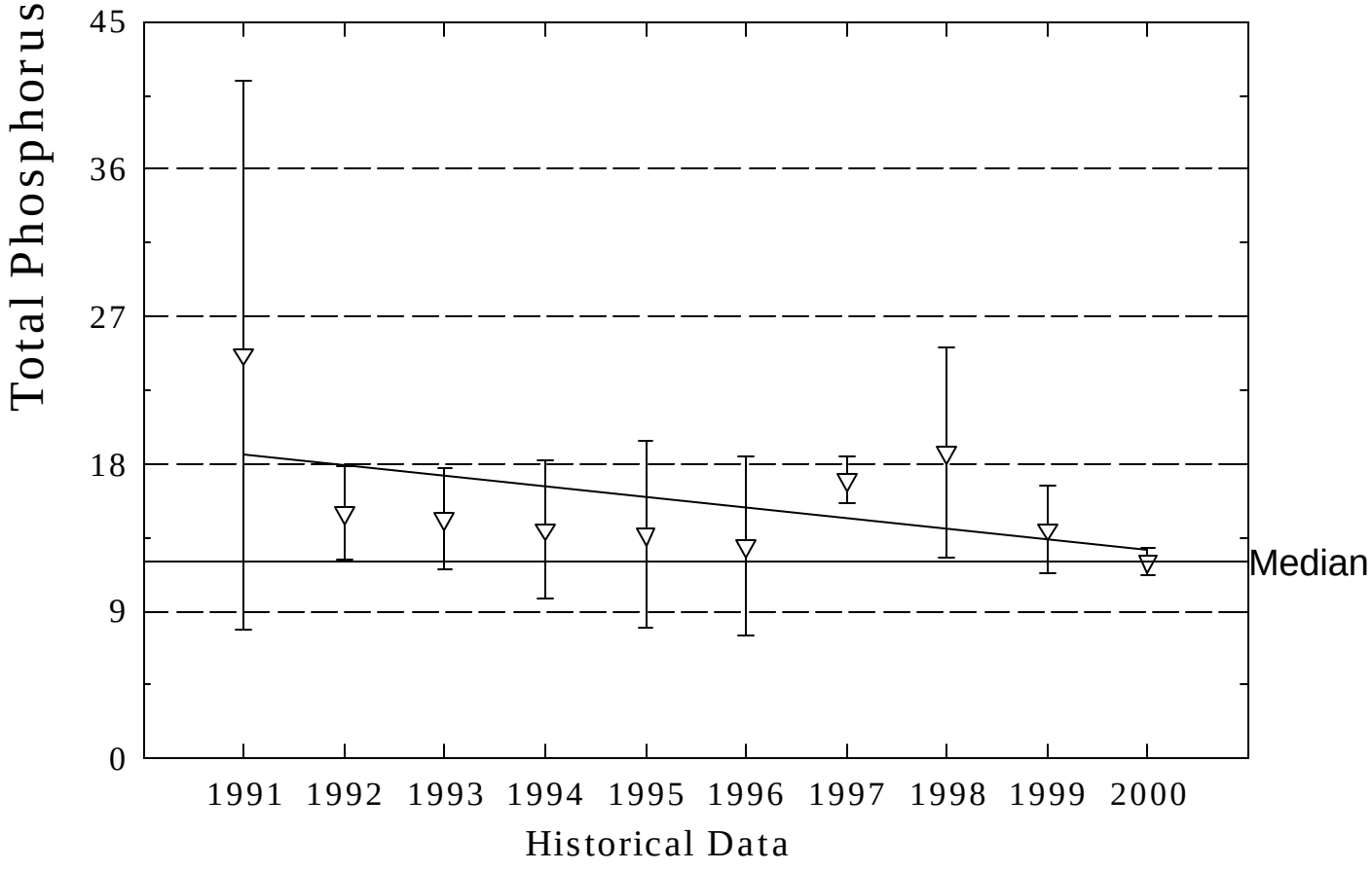


Table 1.

PROVINCE LAKE

EFFINGHAM

Chlorophyll-a results (mg/m^3) for current year and historical sampling periods.

Year	Minimum	Maximum	Mean
1991	1.80	6.87	4.33
1992	2.54	4.93	3.94
1993	2.70	4.50	3.42
1994	2.37	2.61	2.49
1995	1.64	3.65	2.69
1996	3.27	10.64	5.48
1997	3.63	7.13	5.38
1998	2.58	8.63	5.08
1999	2.02	3.82	3.24
2000	3.11	4.77	4.02

Table 2.

PROVINCE LAKE

EFFINGHAM

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
06 / 24 / 1991	ASTERIONELLA	50
	DINOBRYON	30
07 / 16 / 1992	CHRYSOSPHAERELLA	52
	ASTERIONELLA	33
	DINOBRYON	10
07 / 01 / 1993	ASTERIONELLA	67
	DINOBRYON	16
07 / 07 / 1994	ASTERIONELLA	48
	SYNEDRA	18
	DINOBRYON	14
07 / 13 / 1995	DINOBRYON	37
	CHRYSOSPHAERELLA	32
	ASTERIONELLA	13
06 / 06 / 1996	ASTERIONELLA	83
	DINOBRYON	10
	RHIZOSOLENIA	6
08 / 20 / 1997	MELOSIRA	33
	TABELLARIA	33
	GYMNODINIUM	13
06 / 11 / 1998	ASTERIONELLA	80
	DINOBRYON	18
	MELOSIRA	2
08 / 13 / 1998	GYMNODINIUM	69
	CHRYSOSPHAERELLA	29
	MELOSIRA	2
06 / 09 / 1999	ASTERIONELLA	53
	CHRYSOSPHAERELLA	40
	MELOSIRA	3
06 / 09 / 2000	ASTERIONELLA	86
	DINOBRYON	10
	RHIZOSOLENIA	2

Table 3.

PROVINCE LAKE

EFFINGHAM

Summary of current and historical Secchi Disk transparency results (in meters).

Year	Minimum	Maximum	Mean
1991	2.0	2.9	2.5
1992	2.1	3.3	2.7
1993	2.0	3.5	2.9
1994	2.5	3.0	2.7
1995	2.0	3.5	2.9
1996	1.5	4.3	2.9
1997	2.3	2.5	2.4
1998	1.9	2.3	2.0
1999	2.1	3.5	2.7
2000	1.3	2.5	2.0

Table 4.

PROVINCE LAKE

EFFINGHAM

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
ABOVE FARM				
	1993	6.66	6.66	6.66
CAMPGROUND INLET				
	1991	6.60	6.80	6.72
	1992	6.63	6.93	6.77
	1993	6.70	6.89	6.76
	1994	6.36	6.83	6.57
	1995	6.72	6.92	6.79
	1996	6.24	6.85	6.45
	1997	6.64	6.73	6.68
	1998	6.59	6.64	6.62
	1999	6.03	6.70	6.39
	2000	6.70	6.95	6.78
EPILIMNION				
	1991	6.80	6.90	6.86
	1992	6.75	6.89	6.83
	1993	6.82	7.07	6.92
	1994	6.87	6.91	6.89
	1995	6.65	7.06	6.87
	1996	6.49	6.82	6.62
	1997	6.72	6.94	6.82
	1998	6.74	6.91	6.82
	1999	6.05	6.82	6.43
	2000	6.70	7.02	6.83

Table 4.

PROVINCE LAKE

EFFINGHAM

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
HOBBS BROOK				
	1994	6.09	6.09	6.09
	1995	6.29	6.29	6.29
HYPOLIMNION				
	2000	6.60	6.60	6.60
ISLAND INLET HILL				
	1993	6.45	6.45	6.45
ISLAND INLET				
	1991	6.60	6.80	6.69
	1992	6.52	6.80	6.67
	1993	6.30	6.51	6.38
	1994	6.33	6.63	6.46
	1995	6.56	6.81	6.69
	1996	6.26	6.84	6.48
	1997	6.57	6.61	6.59
	1998	6.10	6.24	6.17
	1999	5.85	6.49	6.18
	2000	6.41	6.47	6.44
LOWER CAMPGROUND				
	1993	6.70	6.70	6.70
OUTLET				
	1991	6.70	7.00	6.85
	1992	6.74	7.19	6.97

Table 4.

PROVINCE LAKE

EFFINGHAM

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
OUTLET				
	1993	6.77	7.12	6.90
	1994	6.56	7.05	6.81
	1995	6.85	7.24	7.02
	1996	6.43	6.79	6.60
	1997	6.83	6.95	6.88
	1998	6.63	6.77	6.70
	1999	6.12	6.75	6.46
	2000	6.48	6.94	6.73
RT 153 INLET WOODS				
	1993	6.36	6.36	6.36
RT 153 INLET				
	1991	6.00	6.30	6.12
	1992	5.97	6.34	6.14
	1993	5.92	6.11	6.00
	1994	5.77	6.13	5.94
	1995	6.09	6.21	6.14
	1996	5.69	6.28	5.87
	1997	5.75	6.21	5.98
	1998	5.67	6.17	5.83
	1999	5.57	6.39	5.97
	2000	5.91	6.26	6.08

Table 5.

PROVINCE LAKE

EFFINGHAM

Summary of current and historical Acid Neutralizing Capacity.
Values expressed in mg/L as CaCO .

Epilimnetic Values

Year	Minimum	Maximum	Mean
1991	3.80	3.80	3.80
1992	4.40	4.90	4.65
1993	4.00	5.50	4.77
1994	5.10	5.30	5.20
1995	4.90	6.10	5.57
1996	4.20	5.80	5.14
1997	4.80	5.20	5.00
1998	5.00	5.30	5.13
1999	2.90	4.80	4.15
2000	4.50	5.10	4.83

Table 6.

PROVINCE LAKE

EFFINGHAM

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
ABOVE FARM				
	1993	64.4	64.4	64.4
CAMPGROUND INLET				
	1991	33.6	42.1	36.7
	1992	30.9	35.2	32.9
	1993	30.3	37.0	33.6
	1994	33.9	37.0	35.5
	1995	35.7	52.3	41.4
	1996	23.8	37.8	31.1
	1997	29.3	33.2	30.7
	1998	26.7	27.7	27.0
	1999	32.8	36.7	34.3
	2000	27.3	37.1	33.0
EPILIMNION				
	1991	38.7	40.8	39.4
	1992	40.0	40.5	40.3
	1993	39.4	42.2	40.8
	1994	42.2	43.5	42.8
	1995	43.7	44.7	44.2
	1996	39.5	43.7	41.7
	1997	38.1	38.4	38.2
	1998	38.7	39.3	39.0
	1999	39.8	42.5	41.3
	2000	40.3	41.8	41.2

Table 6.

PROVINCE LAKE

EFFINGHAM

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
HOBBS BROOK				
	1994	34.7	34.7	34.7
	1995	27.4	27.4	27.4
HYPOLIMNION				
	2000	40.2	40.2	40.2
ISLAND INLET HILL				
	1993	64.4	64.4	64.4
ISLAND INLET				
	1991	46.6	50.6	48.2
	1992	44.5	47.3	45.8
	1993	43.4	47.2	45.4
	1994	52.3	55.0	53.9
	1995	45.0	52.5	49.5
	1996	40.0	54.4	48.4
	1997	47.9	50.9	49.4
	1998	43.7	49.0	45.8
	1999	47.0	53.8	50.0
	2000	42.0	43.6	42.7
LOWER CAMPGROUND				
	1993	41.9	41.9	41.9
OUTLET				
	1991	39.0	40.4	39.5
	1992	39.2	40.1	39.7
	1993	39.1	41.6	40.5
	1994	41.6	42.6	41.9

Table 6.

PROVINCE LAKE

EFFINGHAM

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
	1995	42.8	45.2	43.5
	1996	37.1	43.9	41.3
	1997	37.0	38.6	37.7
	1998	37.1	39.8	38.4
	1999	39.4	42.4	41.3
	2000	40.3	41.3	40.8
RT 153 INLET WOODS				
	1993	25.0	25.0	25.0
RT 153 INLET				
	1991	32.2	36.0	33.9
	1992	29.8	40.0	33.7
	1993	27.3	35.6	31.5
	1994	35.4	37.5	36.1
	1995	34.3	37.1	35.5
	1996	23.4	39.9	31.1
	1997	28.4	36.3	31.6
	1998	28.6	30.4	29.6
	1999	33.0	34.5	33.8
	2000	24.6	34.0	30.4

Table 8.

PROVINCE LAKE

EFFINGHAM

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
ABOVE FARM				
	1993	31	31	31
CAMPGROUND INLET				
	1991	13	24	18
	1992	7	34	16
	1993	8	24	14
	1994	12	23	16
	1995	8	11	9
	1996	3	13	7
	1997	3	13	8
	1998	3	14	9
	1999	6	14	9
	2000	< 5	8	6
EPILIMNION				
	1991	15	44	24
	1992	13	17	15
	1993	12	18	14
	1994	11	17	14
	1995	9	20	13
	1996	9	22	13
	1997	16	18	17
	1998	14	26	18
	1999	10	16	14
	2000	11	13	12

Table 8.

PROVINCE LAKE

EFFINGHAM

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
HOBBS BROOK				
	1994	35	35	35
	1995	32	32	32
HYPOLIMNION				
	2000	14	14	14
ISLAND INLET HILL				
	1993	47	47	47
ISLAND INLET				
	1991	28	61	43
	1992	16	44	26
	1993	19	34	26
	1994	38	62	47
	1995	31	73	44
	1996	8	189	50
	1997	20	42	31
	1998	15	54	39
	1999	25	91	48
	2000	37	54	43
LOWER CAMPGROUND				
	1993	11	11	11
OUTLET				
	1991	11	13	11
	1992	9	10	9
	1993	10	16	13
	1994	10	18	13

Table 8.

PROVINCE LAKE

EFFINGHAM

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
	1995	8	11	9
	1996	7	13	10
	1997	10	27	18
	1998	11	16	13
	1999	7	21	15
	2000	10	15	12
RT 153 INLET WOODS				
	1993	6	6	6
RT 153 INLET				
	1991	38	52	43
	1992	18	67	37
	1993	30	40	36
	1994	50	65	59
	1995	31	43	37
	1996	7	44	24
	1997	26	68	46
	1998	13	26	21
	1999	20	138	72
	2000	7	24	16

Table 9.

PROVINCE LAKE

EFFINGHAM

Current year dissolved oxygen and temperature data.

Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
		June 9, 2000	
0.1	17.6	7.8	81.7
1.0	17.6	7.8	81.3
2.0	17.6	7.8	81.5
3.0	17.7	7.8	82.0
3.5	17.8	7.9	82.6

Table 10.

PROVINCE LAKE

EFFINGHAM

Historic Hypolimnetic dissolved oxygen and temperature data.

Date	Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
June 24, 1991	4.0	21.1	6.9	78.0
July 16, 1992	4.4	21.7	8.9	101.8
July 1, 1993	3.5	23.0	9.1	106.0
July 7, 1994	3.5	24.0	6.3	74.0
July 13, 1995	4.0	23.8	7.5	87.0
June 6, 1996	4.5	16.8	5.2	53.0
August 20, 1997	4.5	23.1	9.1	106.0
August 13, 1998	4.0	23.0	0.8	9.0
June 9, 2000	3.5	17.8	7.9	82.6

Table 11.

PROVINCE LAKE

EFFINGHAM

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
CAMPGROUND INLET				
	1997	0.1	0.2	0.1
	1998	0.0	0.3	0.2
	1999	0.1	0.5	0.2
	2000	0.1	0.4	0.2
EPILIMNION				
	1997	0.9	1.3	1.1
	1998	0.8	2.6	1.4
	1999	0.8	1.6	1.2
	2000	0.8	2.4	1.3
HYPOLIMNION				
	2000	11.8	11.8	11.8
ISLAND INLET				
	1997	0.5	0.9	0.7
	1998	0.1	0.9	0.5
	1999	1.2	5.0	2.2
	2000	1.1	1.3	1.2
OUTLET				
	1997	0.5	0.7	0.6
	1998	0.7	1.2	1.0
	1999	1.1	1.8	1.5
	2000	0.7	2.2	1.2
RT 153 INLET				
	1997	0.4	1.2	0.7
	1998	0.4	0.6	0.5

Table 11.

PROVINCE LAKE

EFFINGHAM

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
	1999	0.7	2.7	1.3
	2000	0.3	0.4	0.4